

## Original Research Article

# Mini percutaneous nephrolithotomy. How good it is - a single centre experience

Syed Javid F. Qadri\*, Mufti Mahmood Ahmed, Zafar S. Khanday, Asim Leharwaal

Department of Surgery, Government Medical College Srinagar, Jammu and Kashmir, India

**Received:** 13 December 2020

**Revised:** 22 December 2020

**Accepted:** 23 December 2020

### \*Correspondence:

Dr. Syed Javid Farooq Qadri,

E-mail: [drsyedjavid@gmail.com](mailto:drsyedjavid@gmail.com)

**Copyright:** © the author(s), publisher and licensee Medip Academy. This is an open-access article distributed under the terms of the Creative Commons Attribution Non-Commercial License, which permits unrestricted non-commercial use, distribution, and reproduction in any medium, provided the original work is properly cited.

## ABSTRACT

**Background:** Percutaneous nephrolithotomy (PCNL) is one of the 1st line treatment options for managing renal stones. Miniaturization of this technique has been developed to decrease the morbidity of this technique without compromising the results. Mini PCNL (mPCNL) involves the use of small calibre sheath and nephroscope to tackle renal stones of small to moderate size. The aim of this study is to present the efficacy and technical advantages of mPCNL in managing renal stones.

**Methods:** This was a retrospective single centre study of mPCNL in managing renal stones.

**Results:** From July 2015 to July 2020 192 mPCNL procedures were done at our centre in 175 patients. The median number of stones was 1(1-3) and the average size of calculus was 18.5 mm (6-35) mm. Mean operative time in our study was 46 (35-92) minutes. Fever developed in 15 (7.8%) patients which was managed by parenteral antibiotics, none of our patients required ICU admission. Haemothorax developed in 2 (1%) patients and both of them were managed by tube thoracostomy. We achieved complete clearance in 183 (95.3%) cases. In 9 (4.7%) patients residual calculi were managed by flexible ureteroscopy at 1 month.

**Conclusions:** mPCNL is an effective procedure for management of patients with renal stones with the advantages of less blood loss, short hospital stay and excellent stone clearance rate.

**Keywords:** Mini percutaneous nephrolithotomy, Renal stone, Pneumatic lithotripsy

## INTRODUCTION

Renal stone disease has affected mankind since ages and its incidence continues to increase. With the life time prevalence of 5-10% and risk of recurrence as high as 50% nephrolithiasis is an important cause of morbidity both for the adults and children.<sup>1,2</sup> Currently shock wave lithotripsy (SWL), flexible ureteroscopy (F-URS) and percutaneous nephrolithotomy (PCNL) are the most common first line treatment options used by urologists world wide for managing renal calculi. In contrast to SWL and F-URS PCNL has the distinction of managing any type and size of renal calculus. Over so many years it has

been seen that the efficacy and safety of PCNL is affected by the size of access sheath. By using smaller access sheath, the trauma to the renal parenchyma can be reduced and thus the risk of significant haemorrhage can be minimized.<sup>3</sup> The aim of the present study is to report the outcome of mini PCNL (mPCNL) at our centre with emphasis on the success rate and the technical advantages of this procedure.

## METHODS

This study was a retrospective observational study. Sample size included all the patients who underwent

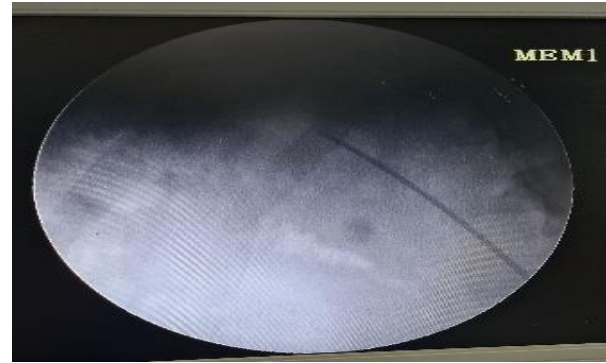
mPCNL from July 2015 to July 2020 at out centre. Inclusion criteria included patients having primary renal stones or residual renal calculi after failed ESWL or failed F-URS. Exclusion criteria included patients harbouring stones in anomalous kidneys, patients with coagulopathy and pregnancy. All the patients were initially clinically worked up and then imaging was done in the form of ultrasound abdomen, X-ray KUB and CT-program. All relevant blood investigations were done including urine culture sensitivity. <sup>99</sup>Tc DTPA scan was done in patients in whom renal function was in question. CT-program was the main investigation which we used to determine the surgical approach of PCNL.

All mPCNL procedures were done using general anaesthesia with endotracheal intubation. In dorsal lithotomy position using rigid cystoscope (17FR) open ended ureteric catheter (5Fr) was placed in the pelvicalyceal system of the desired kidney using fluoroscopic guidance (Figure 1). Patient was turned prone and draped. Puncture was done under fluoroscopic guidance using contrast pyelogram, the calyx which provided direct access to the stone was selected using triangulation method (Figure 2). The puncture was secured by using hydrophilic guidewire, 0.035 inches (Terumo), and then the tract was dilated to accommodate the 16Fr access sheath (Figure 3). 12Fr rigid nephroscope (Richard Wolf, Germany) was used for visualizing the PCS and the calculus (Figure 4).

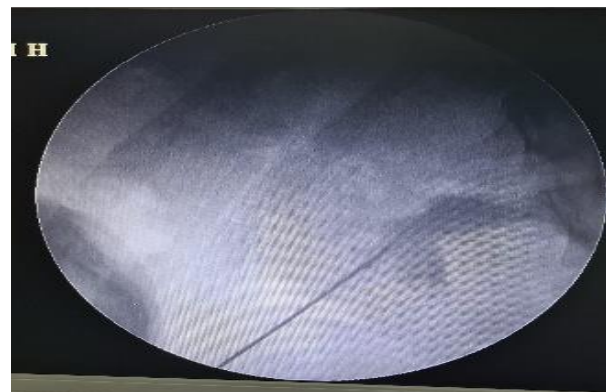
The stone(s) was fragmented with pneumatic lithotripsy (Swiss Lithoclast Master) (Figure 5). Fragments were removed by “vacuum effect” and adherent fragments with tri-radiate 3Fr forceps. Complete stone clearance was confirmed on table and this was followed by placing 5Fr double-J stent. Nephrostomy catheter was placed if deemed necessary (Figure 6 and Figure 7). On the first post-operative day X-ray KUB was done in the morning. On the same day nephrostomy and foley catheter were removed and the patient discharged. 4weeks after the procedure patients underwent non contrast CT scan (NCCT-KUB) for confirming complete stone clearance. Patients with complete clearance under went DJ-stent removal and in whom residual stone fragments were detected underwent F-URS.

Data was analyzed with respect to patient and stone characteristics, operative parameters, complications and outcome. Date analysis was done using SPSS 22.0 software. Continuous values were presented as mean±standard deviation (SD), student t-test and Mann-Whitney U test were used for analysis.

Non continuous numeric values were expressed as median and range. Categorical variables were represented as percentage (%) and analysed using Chi-square test or fisher’s exact test as appropriate. P value less than 0.05 was considered as statistically significant.



**Figure 1: Inferior calyx calculus with ureteric catheter in pelvicalyceal system.**



**Figure 2: Contrast pyelogram with inferior calyceal puncture.**

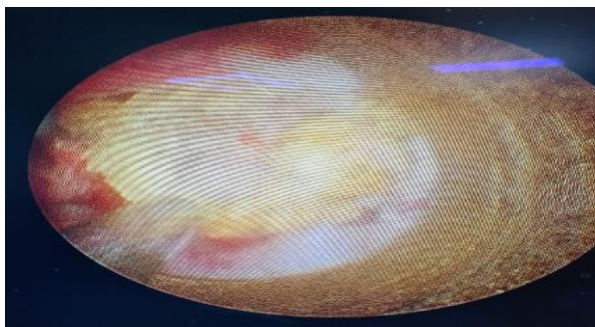


**Figure 3: Single step dilator with sheath in place.**

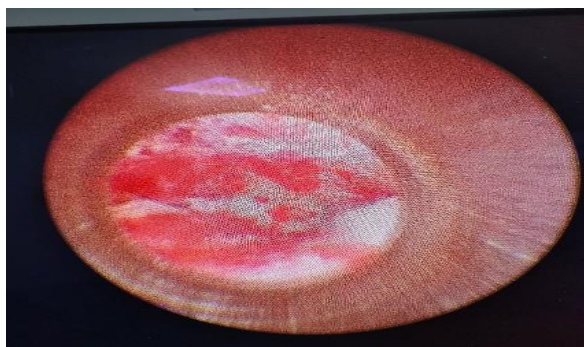


**Figure 4: Mini Nephroscope.**





**Figure 5: Pneumatic energy probe striking the calculus.**



**Figure 6: Complete clearance of calculus.**



**Figure 7: Complete stone clearance, DJ stent in place.**



**Figure 8: Incision after completion of mPCNL.**

## RESULTS

From July 2015 to July 2020 192 mPCNL procedures were done at our centre in 175 patients, 110 (62.8%)

males and 65 (37.2%) females. The mean age of our patients was 48.2(8-69) years. In 112 (58.3%) patients right renal units were operated and in 80 (41.7%) patients left renal units were operated. The median number of stones was 1 (1-3) and the average size of calculus was 18.5 mm (6-35) mm. Stones were located in the renal pelvis in 125 (65.1%), in pelvis and calyces in 42 (21.9%), in calyces only in 17 (8.9%) and at pelviureteric junction in 8 (4.1%) patients.

In all patients mPCNL was done in prone position. In 154(80.2%) renal units single puncture was needed and in 38(19.8%) multiple calyceal punctures were required for stone clearance. In patients in whom only single puncture was made for stone clearance superior calyceal puncture was made in 43 (28%), middle in 31 (20.1%) and inferior calyceal puncture in 80 (51.9%) renal units. In 38 renal units in whom multicalyceal puncture were done viz superior and middle calyx 18 (47.4%), superior and lower calyx 10 (26.3%), middle and lower calyx 8 (21%) and superior, middle and lower in 2 (5.3%). In all cases 12 Fr rigid nephroscope (Richard Wolf, Germany) was used through 16Fr access sheath and pneumatic energy (Lithoclast Master) was used for stone fragmentation. In 128 (66.67%) only vacuum-effect was used for fragment removal but in 64 (33.33%) cases vacuum-effect and tri-probe forceps were used for fragment clearance.

Mean operative time in our study was 46 (35-92) minutes. Post-operative drainage was provided by DJ-stent in all 192 cases but nephrostomy (12Fr) was used in only 13 (6.78%) cases. Median hospital stay in our series of patients was 1 (1-4) day. None of our patients was transfused or develop urine leak. Fever developed in 15 (7.8%) patients which was managed by parenteral antibiotics, none of our patients required ICU admission. Haemothorax developed in 2 (1%) patients and both of them were managed by tube thoracostomy. We achieved complete clearance in 183 (95.3%) cases. In 9 (4.7%) patients residual calculi were managed by flexible ureteroscopy at 1 month.

## DISCUSSION

PCNL procedure for renal stone management was introduced by Fernstrom.<sup>4</sup> PCNL stood the test of time in managing renal stones larger than 2cm.<sup>5</sup> Though the stone clearance rate of PCNL is impressive but it continues to be an invasive procedure. With respect to the renal parenchymal trauma during PCNL it seems that the size of access sheath is critical.<sup>6</sup> Webb et al were the first to attempt performing PCNL using small diameter access sheath.<sup>7</sup> They used 16Fr access sheath and 11Fr paediatric “STING” cystoscope for PCNL. Jackman et al was the first to perform mPCNL in adults using 13Fr URS sheath and he coined the term “mini-perc”.<sup>8</sup> Since then there has been study increase in the use of miniaturized PCNL reflecting its benefits in the form of excellent stone free rate (SFR) with small risk of minor complications (Clavien I-III).

In our study we witnessed excellent stone free rate with minimal complications comparable to internationally reported data.<sup>9</sup> Our observation is that one needs to be well trained in making the exact puncture and tract dilatation for reaping the benefits of mPCNL. There is no prize for using miniaturized PCNL if puncture-tract dilatation is not correct. One can face severe haemorrhage in mPCNL if this step is not done correctly. Additionally, mPCNL has more intra-renal manoeuvrability. One can usually access inferior calyces through middle calyceal tract. The length of upper ureter which can be accessed through middle or superior calyceal access is more with mPCNL as compared to conventional PCNL. Nephrostomy is rarely needed and even skin incision does not need any closure. mPCNL is also an excellent alternative in cases where flexible ureteroscopy could not be done like narrow ureter or urinary diversion cases. Importantly it does not risk the integrity of ureter which is always an adverse possibility during flexible ureteroscopy.<sup>10</sup> mPCNL can be performed in both supine and prone positions. Limited flank exposure and restricted movement of nephroscope are well known limitations of supine PCNL.<sup>11,12</sup> We at our centre perform all cases of PCNL in prone position.

There are multiple technical advantages of mPCNL as compared to cPCNL. In contrast to cPCNL which requires serial alken or amplatz dilators for tract formation mPCNL tract formation is a single step procedure thus reducing fluoroscopic exposure and OT time. In mPCNL we use metallic access sheath. Due to its small cross-sectional area it can be easily advanced through the intercostal spaces in supra 12th punctures. Additionally, metallic sheath reduces the damage to the nephroscope due to the torque which is always a risk in cPCNL. Vision is also excellent with mini nephroscope and we recommend 4Fr difference between size of mini nephroscope and sheath in order to have good low-pressure irrigation moving which significantly improves the vision.

Stone fragmentation in mPCNL is possible with Ho:YAG laser and pneumatic energy. In our series of patients, we used only pneumatic energy with excellent results and we believe it is much faster than laser lithotripsy. Smaller fragments are washed out with “vacuum effect” which is a hydrodynamic effect generated by low pressure continuous flow irrigation.<sup>13,14</sup> Larger fragments and adherent fragments can be retrieved with baskets or tri-radiate graspers. Proponents of laser lithotripsy recommend low energy and high frequency settings for stone fragmentation.<sup>15</sup> This reduces the stone to dust which comes out continuously with the irrigation.

Additional advantage of mPCNL is for accessing proximal ureter antegradely. We believe that the length of ureter which can be accessed during mPCNL is more as compared to cPCNL. In some situations, mPCNL and cPCNL can be used complimentary to each other. In patients where stones are in calyces with no dilatation or

in situations where one is not sure about the exact location of puncture one can start with mPCNL and once proper access is gained one can exchange the sheath of mPCNL with Amplatz sheath and continue the case as cPCNL. Lastly the skin incision in mPCNL does not need any closure with suture or staple. Usually one can apply steri-strip at the incision site (Figure 8).

The limitation of our study is that we used pneumatic lithotripsy for stone fragmentation. Though we achieved good results with it but currently Ho:YAG laser stone dusting/fragmentation is considered the standard of care for use in miniaturized PCNL techniques.

## CONCLUSION

Mini PCNL is an effective modality for treating renal stones. With the advantages of less blood loss, shorter hospital stay and excellent stone free rate one can consider mPCNL as the 1st line percutaneous treatment option for small to medium sized renal stones. One should be adequately trained to perform accurate puncture and tract dilatation to use mPCNL effectively with excellent results.

*Funding: No funding sources*

*Conflict of interest: None declared*

*Ethical approval: Not required*

## REFERENCES

1. Stamatelou KK, Francis ME, Jones CA, Nyberg LM, Curhan GC. Time trends in reported prevalence of kidney stones in the United States. *Kidney Int.* 2003;63:1817–23.
2. Prezioso D, Di Martino M, Galasso R, Iapicca G. Laboratory assessment. *Urol Int.* 2007;79(Suppl 1):20–5.
3. Arslan B, Akbulut MF, Onuk O, Küçüktopçu O, Çilesiz NC, Ozkan A. A comparison of Amplatz dilators and metal dilators for tract dilatation in mini-percutaneous nephrolithotomy. *Int Urol Nephrol.* 2017;49(4):581–5.
4. Fernström I, Johansson B. Percutaneous pyelolithotomy. A new extraction technique. *Scand J Urol Nephrol.* 1976;10:257e9.
5. Xue W, Pacik D, Boellaard W, Breda A, Botoca M, Rassweiler J, et al. Management of single large nonstaghorn renal stones in the CROES PCNL global study. *J Urol.* 2012;187:1293e7.
6. Zhu W, Liu Y, Liu L, Lei M, Yuan J, Wan SP, et al. Minimally invasive versus standard percutaneous nephrolithotomy: a meta-analysis. *Urolithiasis.* 2015;43:563e70.
7. Webb DRTH. Intraluminal surgery of the upper tract. *Dial Paed Urol* 1995;18:2–4.
8. Jackman SV, Docimo SG, Cadeddu JA, Bishoff JT, Kavoussi LR, Jarrett TW. The “mini-perc” technique: a less invasive alternative to

- percutaneous nephrolithotomy. *World J Urol*. 1998;16:3714
9. Hennessey DB, Kinnear NK, Troy A, Angus D, Bolton DM, Webb DR. Mini PCNL for renal calculi: does size matter? *BJU Int*. 2017;119:39-46.
  10. Carter SSC, Cox R, Wickham JEA. Complications associated with ureteroscopy. *Br J Urol*. 1986;58(6):625-8.
  11. Liu L, Zheng S, Xu Y, Wei Q. Systematic review and meta-analysis of percutaneous nephrolithotomy for patients in the supine versus prone position. *J Endourol*. 2010;24:1941-6
  12. Wu P, Wang L, Wang K. Supine versus prone position in percutaneous nephrolithotomy for kidney calculi: a meta-analysis. *Int Urol Nephrol*. 2011;43(1):67-77.
  13. Nagele U, Nicklas A. Vacuum cleaner effect, purging effect, active and passive wash out: a new terminology in hydrodynamic stone retrieval is arising—Does it affect our endourologic routine? *World J Urol*. 2016;34:143-4.
  14. Mager R, Balzereit C, Gust K, Hüsch T, Herrmann T, Nagele U, et al. The hydrodynamic basis of the vacuum cleaner effect in continuous-flow PCNL instruments: an empiric approach and mathematical model. *World J Urol*. 2016;34(5):717-24.
  15. Bader MJ, Pongratz T, Khoder W, Stief CG, Herrmann T, Nagele U, et al. Impact of pulse duration on Ho: YAG laser lithotripsy: fragmentation and dusting performance. *World J Urol*. 2015;33(4):471-7.

**Cite this article as:** Qadri SJF, Ahmed MM, Khanday ZS, Leharwaal A. Mini percutaneous nephrolithotomy. How good it is - a single centre experience. *Int Surg J* 2021;8:86-90.